



Learning Theory and the BSCS 5E Instructional Model

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How People Learn

In **How People Learn** (National Research Council, 2000), the authors summarize three key ideas about learning based on an exhaustive study of the research (p.14-19). These three findings about student learning have parallel implications for classroom instruction (p. 19-21), which then suggest a translation of those implications into curriculum materials. As the authors' state, these three findings imply the following for students and teachers:

Key Findings	Key Findings for Students	Key Findings for Teachers	As a Result, Instructional Materials Need To:
First	Students come to the classroom with preconceptions about how the world works. If their initial knowledge is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but never to their preconceptions outside the classroom.	Recognize preconceptions and adjust instruction	<ul style="list-style-type: none"> • Included structured strategies to elicit and challenge student preconceptions • Incorporated background for the teacher about common preconceptions
Second	To develop competence in an area of a science discipline, students must, (a) have a deep foundation of usable knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) be able to organize that knowledge in ways that facilitate retrieval and application.	Understand the content and conceptual framework for a discipline Provide examples for context	<ul style="list-style-type: none"> • Organized content around a conceptual framework • Connected factual information to the framework • Provided relevant examples to illustrate key ideas
Third	Students must be taught explicitly to take control of their own learning by defining goals and monitoring their progress in achieving them.	Provide class time for goal setting and analysis Teach metacognitive skills	<ul style="list-style-type: none"> • Made learning goals explicit • Integrated metacognitive skill development into content

HOW PEOPLE LEARN

Key Findings

1. Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.
2. To develop competence in an area of inquiry, students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.
3. A “metacognitive” approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.

Implications for Teaching

1. Teachers must draw out and work with the preexisting understandings that their students bring with them.
2. Teachers must teach some subject matter in depth, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge.
3. The teaching of metacognitive skills should be integrated into the curriculum in a variety of subject areas.

Designing Classroom Environments

1. Schools and classrooms must be learner centered.
2. To provide a knowledge-centered classroom environment, attention must be given to what is taught (information, subject matter), why it is taught (understanding), and what competence or mastery looks like.
3. Formative assessments—ongoing assessments designed to make students’ thinking visible to both teachers and students—are essential. They permit the teachers to grasp the students’ preconceptions, understand where the students are in the “developmental corridor” from informal to formal thinking, and design instruction accordingly. In the assessment-centered classroom environment, formative assessments help both teachers and students monitor progress.
4. Learning is influenced in fundamental ways by the context in which it takes place. A community-centered approach requires the development of norms for the classroom and school, as well as connections to the outside world, that support core learning values.

From National Research Council (NRC). (2000). *How people learn*. Washington, D.C.: National Academy Press.

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Engage	The instructor assesses the learners' prior knowledge and helps them become engaged in a new concept by reading a vignette, posing questions, doing a demonstration that has a non-intuitive result (a discrepant event), showing a video clip, or conducting some other short activity that promotes curiosity and elicits prior knowledge.
Explore	Learners work in collaborative teams to complete activities that help them use prior knowledge to generate ideas, explore questions and possibilities, and design and conduct a preliminary inquiry.
Explain	Learners should have an opportunity to explain their current understanding of the main concept. They may explain their understanding of the concept by making presentations, sharing ideas with one another, reviewing current scientific explanations and comparing these to their own understandings, and/or listening to an explanation from the teacher that guides them toward a more in-depth understanding.
Elaborate	Learners elaborate their understanding of the concept by conducting additional activities. They may revisit an earlier activity, project, or idea and build on it, or conduct an activity that requires an application of the concept. The focus in this stage is on adding breadth and depth to current understanding.
Evaluate	The evaluation phase helps both learners and instructors assess how well the learners understand the concept and whether they have met the learning outcomes. There should be opportunities for self assessment as well as formal assessment.

The BSCS 5E Instructional Model

Engage

These experiences mentally engage the students with an event or question. Engagement activities help students to make connections with what they know and can do. During the engagement phase, the teacher can

- Create a need to know/create an interest
- Assess prior knowledge
- Focus on a problem/ask questions

Explore

Students work with one another to explore ideas through hands-on activities. Under the guidance of the teacher, students experience a common set of experiences that helps them clarify their own understanding of major concepts and skills. During the exploration phase, the students

- Investigate
- Develop awareness/practice skills
- Design, plan, build models, collect data
- Test predictions and form new predictions

Explain

Students explain their understanding of the concepts and processes they are learning. Teachers help students clarify their understanding and introduce information related to the concepts to be learned. During the explanation phase, teachers and students

- Clarify understanding
- Define concepts or terms
- Share understandings for feedback
- Listen critically to one another
- Form generalizations
- Refer to previous activities

Elaborate

These activities challenge students to apply what they have learned and extend their knowledge and skills. During the elaboration phase, students

- Build on their understanding of concepts
- Use knowledge of concepts to investigate further—extension
- Apply explanations and skills to new, but similar, situations
- Provide practice and reinforcement –application

Evaluate

Students assess their own knowledge, skills, and abilities. Evaluation activities also allow teachers to evaluate students' progress. During the evaluation phase, students

- Draw conclusions using evidence from previous experiences
- Demonstrate an understanding or knowledge of concept or skill